1. When a sound wave of frequency 300 Hz passes through a medium the maximum displacement of a particle of the medium is 0.1 cm. The maximum velocity of the particle is
(a) 60π cm/sec (b) 30π cm/sec
(c) 30 cm/sec (d) 60 cm/sec

2. Velocity of sound measured in hydrogen and oxygen gas at a given temperature will be in the ratio of
(a) 1 : 1 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1

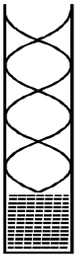
3. Which of the following equations represent a wave
(a) $y = A\sin\omega t$ (b) $y = A\cos kx$
(c) $y = A\sin(at - bx + c)$ (d) $y = A(\omega t - kx)$

4. The transverse wave represented by the equation $y = 4\sin\left(\frac{\pi}{6}\right)\sin(3x - 15t)$ has
(a) amplitude = 4
(b) wavelength $= 4\frac{\pi}{3}$
(c) speed of propagation = 5
(d) period $= \frac{\pi}{15}$

5. A travelling wave in a stretched string is described by the equation $y = A\sin(kx - \omega t)$. The maximum particle velocity is
(a) $A\omega$ (b) $\frac{\omega}{k}$ (c) $\frac{d\omega}{dk}$ (d) $\frac{x}{t}$

6. A 5.5 metre long string has a mass of 0.035 kg. If the tension in the string is 77 N, the speed of a wave on the string is
(a) 110 ms^{-1} (b) 165 ms^{-1}
(c) 77 ms^{-1} (d) 102 ms^{-1}

7. One of the modes of resonance in a tube containing water at one end has been shown. The tube in the present case is in



(a) first harmonic
(b) third harmonic
(c) fifth harmonic
(d) seventh harmonic

8. If fundamental frequency of closed pipe is 50 Hz then frequency of 2nd overtone is
(a) 100 Hz (b) 50 Hz (c) 250 Hz (d) 150 Hz

9. For production of beats the two sources must have
(a) different frequencies and same amplitude
(b) different frequencies
(c) different frequencies, same amplitude and same phase
(d) different frequencies and same phase

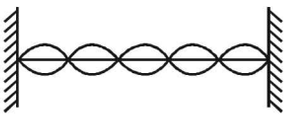
10. Three sound waves of equal amplitudes have frequencies (n–1), n, (n + 1). They superimpose to give beats. The number of beats produced per second will be
(a) 1 (b) 4 (c) 3 (d) 2

11. The superposing waves are represented by the following equations $y_1 = 5\sin 2\pi(10t - 0.1x)$, $y_2 = 10\sin 2\pi(20t - 0.2x)$ Ratio of intensities $\frac{I_{max}}{I_{min.}}$ will be
(a) 1 (b) 9 (c) 4 (d) 16

12. A source of sound of frequency 500 Hz is moving towards a stationary observer with velocity 30 m/s. The speed of sound is 330 m/s. The frequency heard by the observer will be
(a) 545 Hz (b) 580 Hz (c) 458.3 Hz (d) 550 Hz

13. A stretched wire 60 cm long is vibrating with its fundamental frequency of 256 Hz. If the length of the wire is decreased to 15 cm and the tension remains the same, then the fundamental freuqency of the vibration of the wire will be
(a) 1024 (b) 572 (c) 256 (d) 64

14. A string fixed at its both ends vibrates in 5 loops as shown in the figure.



The total number of nodes and antinodes are respectively
(a) 5, 6 (b) 6, 5 (c) 7, 4 (d) 4, 7

15. Newton assumed that sound propagation in a gas takes under
(a) isothermal condition
(b) adiabatic condition
(c) isobaric condition
(d) isochoric condition

16. Speed of sound in mercury at a certain temperature is 1450 m/s. If the density of mercury is 13.6×10^3 kg/m^3 then the bulk modulus for mercury is

(a) 2.86×10^{10} N/m^3 (b) 3.86×10^{10} N/m^3

(c) 4.86×10^{10} N/m^3 (d) 5.86×10^{10} N/m^3

17. The wavelength of a wave in a medium is 0.5 m. The phase difference between the oscillations at two points in the medium due to this wave is $\frac{\pi}{5}$. What is the minimum distance between these point

(a) 0.05m (b) 0.1m (c) 0.25m (d) 0.15m

18. A hospital uses an ultrasonic scanner to locate tumours in a tissue. The operating frequency of the scanner is 4.2 MHz. The speed of sound in a tissue is 1.7 km/s. The wavelength of sound in tissue is close to

(a) 4×10^{-4}m (b) 8×10^{-4}m

(c) 4×10^{-3}m (d) 8×10^{-3}m

19. In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.14 second. The frequency of the wave is

(a) 0.42 Hz (b) 2.75 Hz (c) 1.79 Hz (d) 0.56 Hz

20. Equation of a progressive wave is given by

$y = 4\sin\left[\pi\left(\frac{t}{5}-\frac{x}{9}\right)+\frac{\pi}{6}\right]$ Then which of the following is correct?

(a) v = 5 cm (b) λ = 18 cm

(c) a = 0.04 cm (d) f = 50 Hz

21. The equation of a travelling wave is $y = 60\cos(180\,t - 6x)$ where y is in microns, t in second and x in metres. The ratio of maximum particle velocity to velocity of wave propagation is

(a) 3.6 (b) 3.6×10^{-4}

(c) 3.6×10^{-6} (d) 3.6×10^{-11}

22. A wave travelling along the x-axis is described by the equation $y(x, t) = 0.005\cos(\alpha x - \beta t)$. If the wavelength and the time period of the wave are 0.08 m and 2.0 s, respectively, then α and β in appropriate units are

(a) $\alpha = 25\pi,\ \beta = \pi$ (b) $\alpha = \frac{0.08}{\pi}, \beta = \frac{2.0}{\pi}$

(c) $\alpha = \frac{0.04}{\pi}, \beta = \frac{1.0}{\pi}$ (d) $\alpha = 12.50\pi, \beta = \frac{\pi}{2.0}$

23. The equation of a transverse wave travelling on a rope is given by $y = 10\sin\pi(0.01\,x - 2.00t)$ where y and x are in cm and t in seconds. The maximum transverse speed of a particle in the rope is about

(a) 63 cm/s (b) 75 cm/s

(c) 100 cm/s (d) 121 cm/s

24. A string is producing transverse vibration whose equation is $y = 0.021\sin(x + 30\,t)$, Where x and y are in meters and t is in seconds. If the linear density of the string is 1.3×10^{-4} kg/m, then the tension in the string in N will be

(a) 10 (b) 0.5 (c) 1 (d) 0.117

25. The ratio of fundamental frequency of an organ pipe opened at both ends to that of the organ pipe closed at one end is

(a) 1 : 1 (b) 1.5 : 1 (c) 2 : 1 (d) 3 : 1

26. The frequency of a stretched uniform wire under tension is in resonance with the fundamental frequency of a closed tube. If the tension in the wire is increased by 8 N, it is in resonance with the first overtone of the closed tube. The initial tension in the wire is

(a) 1N (b) 4N (c) 8N (d) 16N

27. Two closed organ pipes, when sounded simultaneously gave 4 beats per sec. If longer pipe has a length of 1 m. Then length of shorter pipe will be, (speed of sound = 300 m/s)

(a) 185.5 cm (b) 94.9 cm (c) 90 cm (d) 80 cm

28. Two coherent sources of different intensities send waves which interfere. The ratio of maximum intensity to the minimum intensity is 25. The intensities of the sources are in the ratio of

(a) 25 : 1 (b) 5 : 1 (c) 9 : 4 (d) 25 : 16

29. The number of beats produced per second by two vibrations: $x_1 = x_0\sin 646\pi t$ and $x_2 = x_0\sin 652\pi t$ is of

(a) 2 (b) 3 (c) 4 (d) 6

30. 10 forks are arranged in increasing order of frequency in such a way that any two nearest tuning forks produce 4 beats/sec. The highest frequency is twice of the lowest. Possible highest and the lowest frequencies (in Hz) are

(a) 80 and 40 (b) 100 and 50

(c) 44 and 22 (d) 72 and 36

31. Two trains are moving towards each other with speeds of 20m/s and 15 m/s relative to the ground. The first train sounds a whistle of frequency 600 Hz. The frequency of the whistle heard by a passenger in the second train before the train meets, is (the speed of sound in air is 340 m/s)

(a) 600 Hz (b) 585 Hz (c) 645 Hz (d) 666 Hz

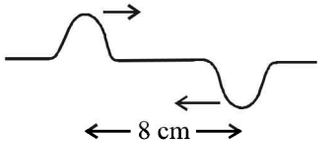
32. Two pulses in a stretched string whose centres are initially 8 cm apart are moving towards each other as shown in the figure. The speed of each pulse is 2 cm/s. After 2 seconds, the total energy of the pulses will be

(a) Zero

(b) Purely kinetic

(c) Purely potential

(d) Partialy kinetic and partialy potential



33. Two waves of lengths 50 cm and 51 cm produce 12 beats per sec. The velocity of sound is

(a) 306 m/s (b) 331 m/s (c) 340 m/s (d) 360 m/s

34. A string of 7 m length has a mass of 0.035 kg. If tension in the string is 60.5 N, then speed of a wave on the string is

(a) 77 m/s (b) 102 m/s (c) 110 m/s (d) 165 m/s

35. A car is moving towards a high cliff. The car driver sounds a horn of frequency f. The reflected sound heard by the driver has frequency $2f$. If v be the velocity of sound, then the velocity of the car, in the same velocity units, will be

(a) v /2 (b) v /$\sqrt{2}$ (c) v /3 (d) v /4

36. A point source emits sound equally in all directions in a non–absorbing medium. Two points P and Q are at distances of 2 m and 3 m respectively from the source. The ratio of the intensities of the waves at P and Q is

(a) 3 : 2 (b) 2 : 3 (c) 9 : 4 (d) 4 : 9

37. Two sources produce sound waves of equal amplitudes and travelling along the same direction producing 18 beats in 3 seconds. If one source has a frequency of 341 Hz, the frequency of the other source may be

(a) 329 or 353 Hz (b) 335 or 347 Hz

(c) 338 or 344 Hz (d) 332 or 350 Hz

38. In order to double the frequency of the fundamental note emitted by a stretched string, the length is reduced to 3/4th of the original length and the tension is changed. The factor by which the tension is to be changed, is

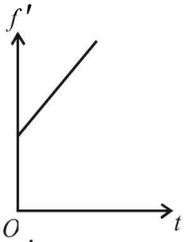
(a) $\frac{3}{8}$ (b) $\frac{2}{3}$ (c) $\frac{8}{9}$ (d) $\frac{9}{4}$

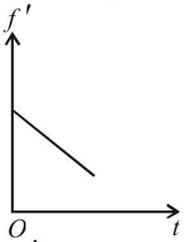
39. Air is blow at the mouth of an open tube of length 25 cm and diameter 2 cm. If the velocity of sound in air is 330 m/sec, then emitted frquencies are (in Hz)

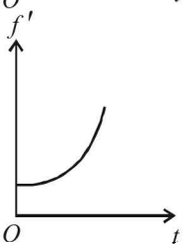
(a) 660, 1320, 2640 (b) 660, 1000, 3300

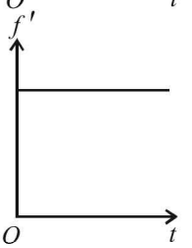
(c) 302, 664, 1320 (d) 330, 990, 1690

40. A source of frequency f is stationary and an observer starts moving towards it at $t = 0$ with constant small acceleration. Then the variation of observed frequency f registered by the observer with time is best represented by

(a) 

(b) 

(c) 

(d) 

41. The speed of longitudinal wave in a wire is 100 times the speed of transverse wave. If Young's modulus of the wire material is 1×10^{11} N/m^2 then the stress in the wire is

(a) 1×10^7 N/m^2 (b) 1.5×10^7 N/m^2

(c) 1×10^{11} N/m^2 (d) 1.5×10^{11} N/m^2

42. A wave of frequency 500 Hz has velocity 360 m/sec. The distance between two nearest points 60° out of phase, is

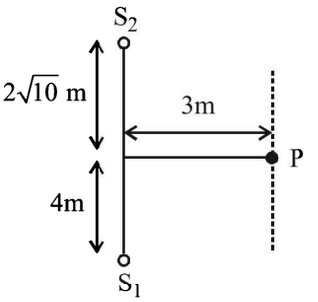
(a) 0.6 cm (b) 12 cm (c) 60 cm (d) 120 cm

43. Equation of motion in the same direction is given by $y_1 = A\sin(\omega t - kx)$, $y_2 = A\sin(\omega t - kx - \theta)$. The amplitude of the medium particle will be

(a) $2A\cos\frac{\theta}{2}$ (b) 2A cosθ

(c) $\sqrt{2}A\cos\frac{\theta}{2}$ (d) $\sqrt{2}A\cos\theta$

44. Two sound sources S_2 and S_1 emit pure sinusoidal coherent waves in phase. If the speed of sound is 340 m/s, then find out the frequencies for which constructive interference occurs at P.



(a) 170 Hz (b) 340 Hz

(c) 510 Hz (d) All of these

45. At which temperature the speed of sound in hydrogen will be same as that of speed of sound in oxygen at 100°C

(a) –148°C (b) –212.5°C (c) –317.5°C (d) –249.7°C

46. When the temperature of an ideal gas is increased by 600 K, the velocity of sound in the gas becomes $\sqrt{3}$ times the initial velocity in it. The initial temperature of the gas is

(a) –73°C (b) 27°C (c) 127°C (d) 327°C

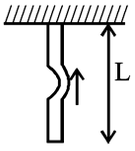
47. Find the frequency of minimum distance between compression and rarefaction of a wire, if the length of the wire is 1m and velocity of sound in air is 360 m/s

(a) 90 s^{-1} (b) 180 s^{-1} (c) 120 s^{-1} (d) 360 s^{-1}

48. Two identical sinusoidal waves each of amplitude 5 mm with a phase difference of $\frac{\pi}{2}$ are treaveling in the same direction in a string. The amplitude of the resultant wave (in mm) is

(a) zero (b) $5\sqrt{2}$ (c) $\frac{5}{\sqrt{2}}$ (d) 2.5

49. A thick uniform rope of length L is hanging from a rigid support. A transverse wave of wavelength λ_0 is set up at the middle of rope as shown in figure. The wavelength of the wave as it reaches to the topmost point is



(a) $2\lambda_0$ (b) $\sqrt{2}\lambda_0$ (c) $\frac{\lambda_0}{\sqrt{2}}$ (d) λ_0

50. Two vibrating tuning forks producing waves given by $y_1 = 27 \sin 600\pi t$ and $y_2 = 27 \sin 604\ \pi t$ are held near the ear of a person, how many beats will be heard in three seconds by him ?

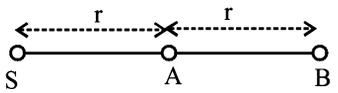
(a) 4 (b) 2 (c) 6 (d) 12

51. When a wave travels in a medium, the particle displacemnt is given by the equation $y = a \sin 2\pi(bt - cx)$ where a, b and c are constants. The maximum particle velocity will be twice the wave velocity if

(a) $c = \frac{1}{\pi a}$ (b) $c = \pi a$

(c) $b = ac$ (d) $b = \frac{1}{ac}$

52. An isotropic point source S of sound emits constant power. Two points A and B separated by a distance r are situated near the source as shown in figure. The difference of the intensity level of sound at the points A & B is about



(a) 3 dB (b) 2 dB (c) 6 dB (d) 12 dB

53. A star, which is emitting radiation at a wavelength of 5000 Å, is approaching the earth with a velocity of 1.50×10^6 m/s. The change in wavelength of the radiation as received on the earth is

(a) 0.25 Å (b) 2.5 Å (c) 25 Å (d) 250 Å

54. A column of air and a tuning fork produce 4 beats per second when sounded together. The tuning fork gives the lower note. The temperature of air is 15°C. When the temperature falls to 10°C, the two produce 3 beats per second. Find the frequency of the fork

(a) 210 Hz (b) 113 Hz (c) 112 Hz (d) 110 Hz

55. The speed of a wave on a string is 150 m/s when the tension is 120 N. The percentage increase in the tension in order to raise the wave speed by 20% is

(a) 44% (b) 40% (c) 20% (d) 10%

56. A hollow pipe of length 0.8 m is closed at one end. At its open end a 0.5 m long uniform string is vibrating in its second harmonic and it resonates with the fundamental frequency of the pipe. If the tension in the wire is 50 N and the speed of sound is 320 ms^{-1}, the mass of the string is

(a) 5 grams (b) 10 grams (c) 20 grams (d) 40 grams

57. A bat flies at a steady speed of 4 ms^{-1} emitting a sound of $f = 90 \times 10^3$ Hz. It is flying horizontally towards vertical wall. The frequency of the reflected sound as detected by the bat will be (Take velocity of sound in air as 330 ms^{-1})

(a) 88.1×10^3 Hz (b) 87.1×10^3 Hz

(c) 92.1×10^3 Hz (d) 89.1×10^3 Hz

58. Two trains are moving towards each other with speeds of 20m/s and 15 m/s relative to the ground. The first train sounds a whistle of frequency 600 Hz. The frequency of the whistle heard by a passenger in the second train before the train meets, is (the speed of sound in air is 340 m/s)

(a) 600 Hz (b) 585 Hz (c) 645 Hz (d) 666 Hz

59. Two cars are moving on two perpendicular roads towards a crossing with uniform speeds of 72 km/hr and 36 km/hr. If first car blows horn of frequency 280 Hz, then the frequency of horn heard by the driver of second car when line joining the cars make 45° angle with the roads; will be

(a) 321 Hz (b) 298 Hz (c) 289 Hz (d) 280 Hz

60. A source is moving towards a stationary obsurber, so that the apparent frequency increases by 50% If velocity of sound is 330 m/sec, then velocity of source is-

(a) 220 m/sec (b) 180 m/sec

(c) 150 m/sec (d) 110 m/sec

ANSWER KEY

1	(a)	**3**	(c)	**5**	(a)	**7**	(d)	**9**	(b)	**11**	(b)	**13**	(a)	**15**	(a)				
2	(d)	**4**	(c)	**6**	(a)	**8**	(c)	**10**	(d)	**12**	(d)	**14**	(b)						
16	(a)	**20**	(b)	**24**	(d)	**28**	(c)	**32**	(b)	**36**	(c)	**40**	(a)	**44**	(d)	**48**	(b)		
17	(a)	**21**	(b)	**25**	(c)	**29**	(b)	**33**	(a)	**37**	(b)	**41**	(a)	**45**	(d)	**49**	(b)		
18	(a)	**22**	(a)	**26**	(a)	**30**	(d)	**34**	(c)	**38**	(d)	**42**	(b)	**46**	(b)	**50**	(c)		
19	(c)	**23**	(a)	**27**	(b)	**31**	(d)	**35**	(c)	**39**	(a)	**43**	(a)	**47**	(b)				
51	(a)	**52**	(c)	**53**	(c)	**54**	(d)	**55**	(a)	**56**	(b)	**57**	(c)	**58**	(d)	**59**	(b)	**60**	(d)